

What is claimed is:

1 1. A method for storing an XML document in a relational database system which
2 comprises, in combination, the steps of:
3 parsing the character data in said XML document to identify characters representing data
4 values within at least some of the elements of said XML document,
5 storing each of said data values in a specified column location in one or more specified
6 rows of one or more specified tables in said relational database system,
7 removing at least some of said data values from said XML document and storing the
8 remainder of said XML document in said database as an XML skeleton which defines the
9 structure of said XML document,
10 thereafter reconstructing said XML document by merging the data content of said
11 specified rows with said XML skeleton.

1 2. The method set forth in claim 1 wherein the data value stored in each of said specified
2 columns is obtained from a leaf element of said XML document which contains no sub element.

1 3. The method set forth in claim 2 wherein the data values stored in each given one of
2 said specified rows is obtained from an XML element which contain one or more of given ones
3 of said leaf elements, the data values in said given ones of said leaf elements being stored in
4 columns in said given one of said specified rows.

1 4. The method set forth in claim 3 further includes the step of storing data describing the
2 properties of at least selected ones of said data values.

1 5. The method set forth in claim 4 wherein said properties include the designation of one
2 or more of said data values as a primary key for use by said relational database system.

1 6. The method set forth in claim 5 wherein said properties further include the designation
2 of the data type for at least some of said data values.

1 7. The method set forth in claim 6 wherein said properties further include the designation
2 of one or more of said data values as indexing values.

1 8. The method set forth in claim 1 further including the step of designating one or more
2 of said elements of said XML documents as static elements and for identifying said static
3 elements during said step of removing at least some of said data values to prevent removal of the
4 data values in said static elements so that said data values in said static elements are retained in
5 said XML skeleton.

1 9. A method for storing an XML document as set forth in claim 1 further comprising the
2 step of performing a relational database operation to modify the data value stored in at least one
3 of said column locations such that the step of reconstructing said XML document produces a
4 modified XML document.

1 10. The method for storing an XML document as set forth in claim 4 wherein said step
2 of storing data describing the properties of at least selected ones of said data values comprises
3 means for storing an XML Descriptor which includes information obtained from the document
4 type definition (DTD) associated with said XML document.

1 11. The method set forth in claim 10 wherein said XML Descriptor further specifies one
2 or more of the elements of said XML document which contain primary key data values, and
3 wherein said step of removing at least some of said data values does not remove said primary
4 key data values but instead retains said primary key values in said skeleton

1 12. The method set forth in claim 11 wherein said XML Descriptor further specifies the
2 data type of the data values in one or more specified elements of said XML document.

1 13. The method set forth in claim 12 wherein said XML Descriptor further identifies one
2 or more of said data values as indexed data values.

1 14. Apparatus for storing an XML document in a relational database which comprises, in
2 combination, the steps of:

3 means for parsing said XML document to identify one or more element data values stored
4 in one or more corresponding named elements of said XML document,

5 means for parsing said XML document to derive tree definition data which specifies the
6 hierarchical relationship between the said named elements of said XML document,

7 means for storing said data values in one or more specified column locations in one or
8 more rows of one or more relational tables in said relational database,

9 means for storing said tree definition data in said relational database,

10 means for performing one or more relational operations on one or more of said data
11 values stored in said one or more tables, and

12 means for reconstructing said XML document by combining said data values stored in
13 said relational tables with said tree definition data stored in said database.

1 15. Apparatus as set forth in claim 14 wherein said means for performing one or more
2 relational operations includes means for dynamically modifying one or more of said data values
3 and wherein said means for reconstructing said XML document produces a modified XML
4 document containing data values modified by said one or more relational operations.

1 16. Apparatus as set forth in claim 15 wherein said relational operations include queries
2 which selectively retrieve and perform designated operations with respect to said data values.

1 17. Apparatus as set forth in claim 15 wherein said relation operations include operations
2 which delete or modify one or more of said data values and wherein said apparatus further
3 includes means for storing relational integrity constraints which regulate the performance of said
4 operations which delete or modify.

1 18. Apparatus as set forth in claim 14 further including means for storing data type
2 designations for one or more of said named elements of said XML documents and for storing
3 data values in said relational database in accordance with said data type designations.

1 19. Apparatus as set forth in claim 14 wherein said means for storing tree definition data
2 includes means for removing one or more of said element data values from said XML document
3 and for storing the remainder of said XML document as an XML skeleton

1 20. Apparatus as set forth in claim 19 wherein said means for reconstructing said XML
2 document comprises means for re-inserting said data values from said relational tables into said
3 XML skeleton and for generating the merged combination of said skeleton and said data values
4 as an XML document.